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IPS PINI ATTACK DENSITY IN PONDEROSA PINE THINNING SLASH AS RELATED TO FELLING DATE IN EASTERN OREGON [1]

by

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ABSTRACT

Ips pini *attacked 86 percent of the ponderosa pine thinning slash felled during 3 years near Burns, Oreg. Density of attack averaged 10.8 per square foot of bark surface and varied slightly with felling date. Conclusion: Dense attack in slash ordinarily should be expected following pre-commercial thinnings in eastern Oregon.*

INTRODUCTION

The pine engraver, *Ips pini* (Say)[2] (Coleoptera: Scolytidae), is a major cause of postthinning mortality of ponderosa pine, *Pinus ponderosa* Laws., in eastern Oregon. During the first spring or summer after thinning, beetle populations migrate into residual stands and ordinarily seem to confine their attacks to the thinning slash. However, in warm, dry years they may kill many intended crop trees. In

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[1] Part of Master of Science thesis, University of Idaho, Moscow.

[2] This insect was known in the Western United States as the Oregon pine ips, *Ips oregoni* (Eichhoff), until a recent generic revision by Hopping (1964).

a 3-year study in the early 1940's, Buckhorn[3/] found that more than 95 percent of ips-caused mortality in recently logged stands occurred where cuttings had been made from February through July. When thinning programs were begun in east-side forests during the 1950's, he recommended that thinnings be scheduled to avoid the "hazardous" February-July period. But, by the early 1960's, such extensive acreages were being treated that many land managers found it very difficult to restrict thinnings to the "safe" months of August to January, and they requested information on how to thin safely during the hazardous months. This study aimed toward explaining the association of damage hazard with date of thinning or slash deposition and was a test of the hypothesis that this hazard is directly related to density of *Ips pini* attack in the thinning slash.

METHODS

This study was conducted in the Malheur National Forest, about 40 miles north of Burns and about 80 miles east of where Buckhorn studied. According to Dolph,[4/] this area is within a zone of high outbreak frequency. Severe tree killing was extensive here in the summer of 1962,[5/] but only scattered, endemic killing occurred during the years of study. Data were collected at elevations ranging from 4,700 to 5,400 feet.

Ips pini has two generations per year in the study area.[6/] Overwintering adults emerge and attack in April or May. The first generation subsequently emerges and attacks during midsummer. The second generation overwinters and does not fly until the subsequent spring. In this locality, slash felled after early August is seldom attacked in the same calendar year, but some earlier felled materials may be attacked as late as early September.

3/ W. J. Buckhorn. Preliminary report on the relation of logging operations to outbreaks of *Ips oregoni* in ponderosa pine forests. Unpublished report on file at Pacific Northwest Forest & Range Experiment Station, Portland, Oreg. July 8, 1942.

4/ R. E. Dolph, Jr. Summary of Oregon pine ips damage in the Pacific Northwest from 1952 to 1962, and suggested measures for preventing outbreaks in young ponderosa pine stands. Division of Timber Management, Pacific Northwest Regional Office, USDA Forest Service, Portland, Oreg. April 1965.

5/ D. G. Mook. *Ips* infestation analysis. Unpublished report, Division of Timber Management, Pacific Northwest Regional Office, USDA Forest Service, Portland, Oreg. Feb. 25, 1963.

6/ C. Sartwell, Jr. Mountain pine beetle and Oregon pine ips: progress report on 1963 exploratory studies. Unpublished report on file at Pacific Northwest Forest & Range Experiment Station, Portland, Oreg. Aug. 1, 1964.

The sampled slash was felled in operational, precommercial thinnings in the 3-year period from August 1962 to July 1965. Approximately 2,000 acres were thinned to a 12- by 12-foot spacing, which resulted in about 500 to 800 felled trees per acre. Most trees up to 5.5-inch d.b.h., occasionally a few larger, were cut and left where felled.

A plot consisted of slash felled in a particular month and year, and slash was available for 32 of the possible 36 months. Sampling for density of attacks was done 1 year after felling when the slash was either abandoned by *Ips pini* or presumably no longer attractive to it. The sampling unit was a 1-foot-long bolt cut from the trunk of a slash tree at what had been 4 to 5 feet above ground level before felling. To select slash trees for samples, a string line was laid in a cardinal direction across the approximate middle of the plot; and, starting 100 feet into the plot, every 10th felled tree crossed by this line was sampled. Ten samples were taken from each plot for a grand total of 320. The sample bolts were brought to a laboratory, where the bark was completely removed and the attacks (nuptial chambers) were counted.

No quantitative data about tree mortality were obtained, as the study intent was to relate density of attack in slash with the mortality hazard to residual trees as established by Buckhorn's findings.

RESULTS

The pine engraver attacked 86 percent of the sampled slash trees, which is similar to attack in 80 percent of the ponderosa pine logging slash studied by Buckhorn in the nearby Ochoco National Forest. But Schenk et al. (1957) found that only 60 and 21 percent of the slash was infested by *Ips pini* after two precommercial thinnings of jack pine in Wisconsin, and McComb (1955) reported that about 30 to 65 percent of Engelmann spruce (*Picea engelmannii* Parry) trap trees in Montana were attacked by this beetle.

Mean density of attack per square foot of bark surface was 10.8 for all samples and 12.6 for only the attacked samples. These values are about three times greater than Reid (1957) found in lodgepole pine (*Pinus contorta* Dougl.) slash in the Canadian Rocky Mountains but are similar to those in selected pieces of heavily attacked slash reported by Cameron and Borden (1967) for *Ips confusus* (LeConte) in ponderosa pine in California and by Mason (1965) for the combination of *Ips avulsus* (Eichhoff) and *Ips grandicollis* (Eichhoff) in loblolly pine in Tennessee. In short, a rather large *Ips pini* population was present in the study area.

Contrary to the original study hypothesis, attacks were not densest in slash felled in the hazardous months. Rather, as shown in table 1, they averaged slightly higher in thinning debris deposited in the safe August-January months. However, this difference was due mainly to

variation within the year 1963-64, when attacks in safe slash were nearly three times as dense as in materials felled in the hazardous February-July months. In the other two seasons, density of attacks was not significantly different between safe and hazardous slash.

Table 1.--*Mean* Ips pini *attacks per square foot of bark surface by group of felling months*

Felling month group	Year slash felled			3 years
	1962-63	1963-64	1964-65	
Aug.-Jan. (safe)	16.7	15.9	6.2	12.5
Feb.-July (hazardous)	14.2	6.2	7.5	9.1
Difference	(1/)	**	(1/)	*

* Difference statistically significant at 95-percent level.
** Difference statistically significant at 99-percent level.
1/ Not significant.

As is evident in table 2 and figure 1, there was some indication of a trend toward two peaks in the relation of density of attack to particular month of felling. This suggests that, at time of main beetle flight both in the spring and midsummer, some available slash probably was too old and some was too fresh for maximum attraction of attacking beetles. However, as indicated by the wide 95-percent confidence intervals for the 3-year means, density of attacks was too variable within months and between years to confirm this trend. Notwithstanding this variability, the data in table 2 and figure 1 confirm those in table 1 in showing that the slash felled in the hazardous months of February through July was not attacked more densely than that felled in the safe months of August through January.

DISCUSSION

The findings here do not explain why *Ips pini* is more likely to kill residual trees following February-July thinnings than after August-January treatments. But they do indicate that, in current operational thinning situations, the difference in damage hazard is not directly related to abundance of attacking beetles. Theoretically, of course,

Table 2.--*Mean* Ips pini *attacks per square foot of bark surface as related to particular month of felling of ponderosa pine thinning slash*

Month slash felled	Year slash felled			3 years	95-percent confidence intervals
	1962-63	1963-64	1964-65		
Aug.	12.4	8.1	1.6	7.4	5.0- 9.8
Sept.	14.8	--	3.1	9.0	5.0-13.0
Oct.	--	20.0	4.4	12.2	6.5-17.9
Nov.	18.5	18.2	6.4	14.4	10.6-18.2
Dec.	25.5	13.9	10.7	16.7	12.8-20.6
Jan.	12.5	19.2	10.8	14.2	11.1-17.3
Feb.	8.3	5.9	10.6	8.3	6.1-10.5
Mar.	14.7	6.7	6.6	9.3	6.7-11.9
Apr.	--	6.3	8.4	7.3	4.6-10.0
May	10.8	7.5	4.8	7.7	4.8-10.6
June	22.1	7.8	7.0	12.3	8.8-15.8
July	15.2	3.2	--	9.2	5.4-13.0
Year	15.5	10.6	6.8	10.8	9.8-11.8

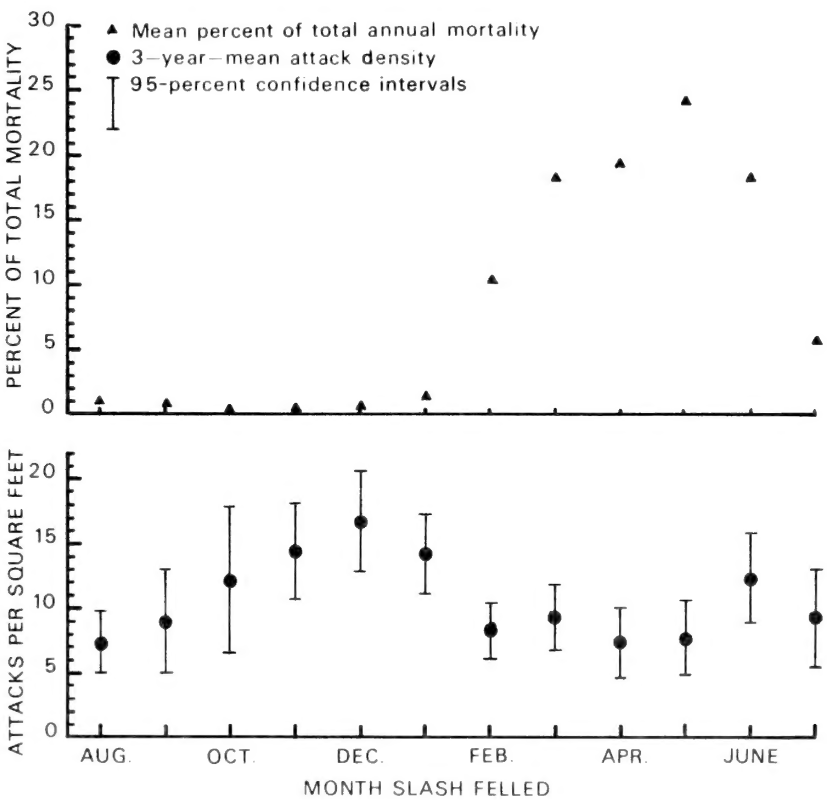

Figure 1.--Tree mortality caused by *Ips pini* (unpublished data from Buckhorn) and attack density in thinning slash as related to month of thinning or felling.

a large beetle population is one prerequisite to the occurrence of severe tree mortality. But in the study area, which is typical of much of eastern Oregon, beetles are so generally abundant that this prerequisite is usually met.

For further understanding of why damage probability is associated with felling date, it is necessary to clarify whether tree killing occurs predominantly when beetles are migrating into a stand to attack the slash or while newly emerged beetles are abandoning the slash in which they developed. Circumstantial and observational evidence strongly indicate that, as Person reported (see Keen and Craighead 1927) for western pine beetle, *Dendroctonus brevicomis* LeConte, the great bulk of the killing by *Ips pini* occurs while the slash is under attack, rather than when beetles bred in the slash are emerging from it. During this study it was observed that beetles emerging from overwintering sites attacked mainly in August-January slash. Wygant and Rodriguez-Lara (1967) have pointed out that tree killing by these spring-flying beetles rarely reaches pest problem proportions. It is also evident from Buckhorn's findings that the first generation adults cause very little killing in the stands where they develop. Because the second generation does not fly until after overwintering, it is clear that tree killing occurs mainly in midsummer while the first generation adults are migrating into new slash areas--mostly stands where slash was felled from February through July.

The studies of Vité (1961) and Stark (1965) indicate that ponderosa pine resistance to attack by bark beetles generally is highest in the spring and declines through the summer. Thus, one explanation of the higher ips-caused mortality associated with February-July thinnings is that *Ips pini* migration into these stands during midsummer occurs at a time when residual tree resistance to attack is relatively low. Conversely, mortality is lower in stands thinned August-January because attacking beetles invade these stands in the spring when tree resistance is higher.

Another explanation, perhaps complementary to the preceding, is that capacity of *Ips pini* populations to overcome trees may be greater in midsummer than in the spring because attacking beetles concentrate more rapidly in warm weather than in cool. Although similar numbers of beetles may invade two comparable stands, the threat to residual trees would be greater where beetle migration is concentrated in time than where it is protracted. Mason (1970) suggests that in the Southern United States the more rapid aggregation of *Ips avulsus* (Eichhoff) partly explains why it is a more important tree killer than *Ips grandicollis* (Eichhoff), which does not aggregate as rapidly when attacking. Thus, rapid aggregation of beetles would seem a prerequisite to tree killing by *Ips* bark beetles, and the hypothesis here is that this is more likely to occur in midsummer than in spring.

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